DOCUMENT RESUME

ED 209 511 CE 030 556

AUTHOR Lawrence, Allen; And Others
TITLE Energy Sources (Energy/Power). Industrial Arts, Senior High--Level II. North Dakota Senior High Industrial Arts Curriculum Guides.
INSTITUTION North Dakota Univ., Grand Forks. Dept. of Industrial Technology.
SPONS AGENCY North Dakota State Board for Vocational Education, Bismarck. Research Coordinating Unit.; Office of Education (DHEW), Washington, D.C.
PUB DATE 81
NOTE 57p.; For related documents see CE 030 555-566 and ED 173 662.

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS Behavioral Objectives; Careers; Course Descriptions; Course Objectives; Curriculum Guides; *Energy; Guidelines; High Schools; *Industrial Arts; Learning Activities; *Nuclear Energy; *Power Technology; *Solar Radiation; Trade and Industrial Education
IDENTIFIERS *Energy Sources; *Geothermal Energy; North Dakota

ABSTRACT

This course guide for an energy sources course is one of four developed for the energy/power area in the North Dakota senior high industrial arts education program. (Eight other guides are available for two other areas of Industrial Arts--graphic communications and production.) Part 1 provides such introductory information as a definition and instructional objectives for Industrial Arts. Part 2 contains the course rationale and objectives; guidelines for implementation; taxonometric structure; course description including length, credit, prerequisites, and student competencies; suggested instructional units with required number of class periods; and seven units. Each unit includes some or all of the following material: unit objective(s), topic outline, and selected student competencies to be developed through sample coordinated learning activities. Unit titles are Introduction to Energy Sources, Chemical Energy Sources, Electrical Energy Sources, Solar Radiated (Light/Thermal) Energy Sources, Mechanical Energy Sources, Nuclear/Atomic Energy Sources, and Geothermal Energy Sources. A reference list is appended. (YLB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED209511

NORTH DAKOTA SENIOR HIGH
INDUSTRIAL ARTS
CURRICULUM GUIDES

ENERGY SOURCES

(ENERGY / POWER)

INDUSTRIAL ARTS
SENIOR HIGH--LEVEL II

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

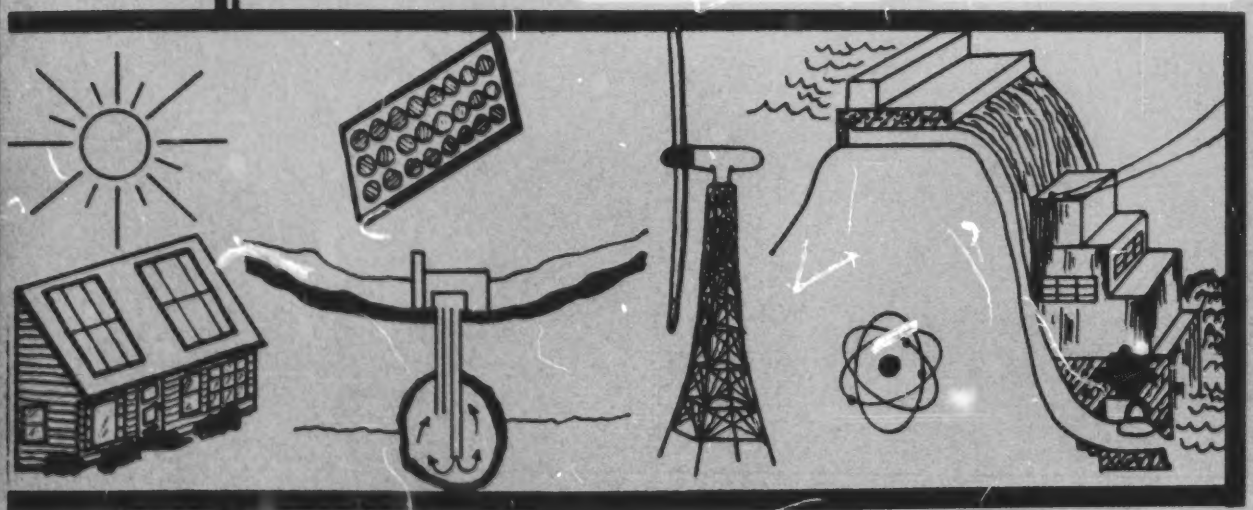
✓ This document has been reproduced as received from the person or organization originating it.
Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

L. Bamhart

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."



NORTH DAKOTA

CE030556

NORTH DAKOTA STATE BOARD FOR
VOCATIONAL EDUCATION
Bismarck, North Dakota

NORTH DAKOTA SENIOR HIGH INDUSTRIAL ARTS CURRICULUM GUIDES

Myron Bender, Project Director
University of North Dakota
Department of Industrial Technology
Grand Forks, North Dakota

Supported by
The North Dakota State Board For Vocational Education
Research Coordinating Unit
900 East Boulevard
Bismarck, North Dakota 58505

Published By
Graphic Communications Laboratory
University of North Dakota
1981

The research reported herein was performed to a grant with the Office of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

PREFACE

One of the biggest challenges facing education today is keeping the instructional content current. Industrial Arts in particular must be quick to respond to changes in our technological society. For many years, North Dakota has offered quality industrial arts programs to students in the public schools. Credit for this is due to the teachers who have shown the desire to continually improve programs, keep their content current, and make instruction relevant.

The Industrial Arts curriculum has boundless potential for courses and program development. However, this program possibility excites the imagination of teachers to offer endless number of courses which causes a need to determine what is of greatest value for students to experience.

Thus, the development of an appropriate or model curriculum requires a critical examination of several undergirding questions: What is the overall responsibility of Industrial Arts? What Industrial Arts goals are appropriate for the different grades or school levels? What courses constitute a meaningful curriculum for these goals to be realized? What shall be the scope and sequence of the total curriculum? The answers to these questions have been addressed by a North Dakota Industrial Arts Master Plan curriculum committee and are recorded in the North Dakota Senior High Industrial Arts Program of Studies booklet.

The Program of Studies describes the complete secondary school industrial arts education. The Program of Studies Booklet emphasizes the Level II Senior High programs with specific courses, course descriptions, objectives and units of instruction. The Junior High-Level I program is dealt with in a general basis for the purpose of articulating the two levels within the total secondary school industrial arts program.

Three types of Industrial Arts programs are included in the Program of Studies along with the individual courses which constitute the complete secondary school curriculum:

1. ORIENTATION AND EXPLORATION-- Level I program designed for grades seven through nine. The purpose of this program is to provide students with first-hand exploratory experiences in the four technical cluster areas. The learning experiences should provide an awareness of the impact of industry and it's associated technologies on the lives of individuals. Furthermore, this program assists individuals in making informed and meaningful occupational/career choices.
2. PERSONAL ENRICHMENT-- The program designed to prepare students with a general education of technolgical literacy, avocational skills and consumer information. This is purely an elective program of students for students who desire to gain an understanding of the technical concepts for personal satisfaction.
3. PRE-TECHNICAL-- This program provides concentrated and specialized technical courses for grades ten through twelve. These courses are articulated with the Level I technical cluster areas. Students at this level have a wide range of interests, abilities, and life aspirations. Therefore, the key element for the senior high pre-technical program is flexibility to meet the varied needs of learners. The program is designed to prepare students for advanced educational or training programs.

The North Dakota Senior High Program of Studies identified twelve different courses recommended to be offered in grades ten, eleven and twelve. The model curriculum lists four courses for each of three technical areas: (1) Energy/power, (2) Graphic Communications, and (3) Production. Individual course guides have been developed for each of the twelve courses recommended for the senior high curriculum. This being one of the twelve course guides. Similar guides have been developed for the remaining eleven.

Each course guide contains the course rationale, objectives, content, units and selected student competencies to be developed along with student learning activities. The primary aim of the course guides is to provide meaningful direction and still leave opportunity for individual teacher creative approaches in meeting the diverse needs of unique school populations. The course guides not only proposes to assist teachers and administrators in keeping their programs up-to-date, but also to promote industrial arts education program uniformity among North Dakota schools.

Ernest Breznay

Ernest Breznay
State Industrial Arts Supervisor
North Dakota State Board for Vocational Education
July, 1981

ACKNOWLEDGEMENTS

The North Dakota Industrial Arts profession is indebted to the following individuals who gave their time and talents in the development of the Twelve Senior High Industrial Arts course guides. These teachers and teacher educators attended an Organizational meeting, participated in a curriculum writing seminar, and developed individual course guides during 1980 & 1981.

PROJECT STAFF

Dr. Myron Bender, Project Director
Department of Industrial Technology
University of North Dakota
Grand Forks, North Dakota 58202

Mr. Ernest Breznay, Coordinator
State Industrial Arts Supervisor
North Dakota State Board for
Vocational Education
Bismarck, North Dakota 58505

COURSE GUIDE WRITERS & CONSULTANTS

PRODUCTION COURSES

Dr. Robert Claus, Writer
Department of Industrial Education
Valley City State College
Valley City, North Dakota 58072

Mr. Isaac Hill, Writer
Langdon High School
Langdon, North Dakota 58249

Dr. Luvern R. Eickhoff, Consultant
Department of Industrial Technology
University of North Dakota
Grand Forks, North Dakota 58202

Mr. Larry Gander, Writer
Mayville-Portland High School
Mayville, North Dakota 58257

Mr. Arlo Mittleider, Writer
Page High School
Page, North Dakota 58064

GRAPHIC COMMUNICATIONS COURSES

Mr. Eddie Poehls, Writer
Tolna High School
Tolna, North Dakota 58380

Mr. Keith Stenehjem, Writer
Department of Industrial Technology
University of North Dakota
Grand Forks, North Dakota 58202

Dr. Wan-Lee Cheng, Consultant
Department of Industrial Technology
University of North Dakota
Grand Forks, North Dakota 58202

Mr. John Torgerson, Writer
Fargo South High School
Fargo, North Dakota 58102

Mr. Thomas Sweet, Writer
Bismarck High School
Bismarck, North Dakota 58501

ENERGY / POWER COURSES

Mr. Allen Lawrence, Writer
Thompson High School
Thompson, North Dakota 58278

Mr. Lyle Siedschlaw, Writer
Linton High School
Linton, North Dakota 58552

Dr. Don Mugan, Writer
Industrial Education Department
Valley City State College
Valley City, North Dakota 58072

Dr. John Sinn, Writer
Department of Industrial Technology
University of North Dakota
Grand Forks, North Dakota 58202

Dr. Herbert J. Auer, Consultant
Department of Industrial Technology
University of North Dakota
Grand Forks, North Dakota 58202

STAFF ASSISTANTS

A special thanks is due to individuals who assisted with the design, layout, typing, and printing of the twelve industrial arts course guides.

Dr. Wan-Lee Cheng
Production Coordinator
Department of Industrial Technology
University of North Dakota
Grand Forks, North Dakota 58202

Mrs. Sandy Tessier
Secretary/Typist
Department of Industrial Technology
University of North Dakota
Grand Forks, North Dakota 58202

Mr. Paul Franzmeier, Artist
Department of Industrial Technology
University of North Dakota
Grand Forks, North Dakota 58202

Mr. Keith Stenehjem
Production Assistant
Department of Industrial Technology
University of North Dakota
Grand Forks, North Dakota 58202

Mrs. Roslyn O. Groomes
Comp/Set Typesetter
Department of Industrial Technology
University of North Dakota
Grand Forks, North Dakota 58202

Mr. Douglas Hisey, Jr.
Layout Assistant
Department of Industrial Technology
Grand Forks, North Dakota 58202

TABLE OF CONTENTS

Page

PART I: INTRODUCTION

-PREFACE ii
-ACKNOWLEDGEMENTS iv
-BASIC BELIEFS ABOUT INDUSTRIAL ARTS 1
-THE INDUSTRIAL ARTS MISSION & GOALS 2
-INSTRUCTIONAL OBJECTIVES 3
-NORTH DAKOTA INDUSTRIAL ARTS 4
-THE PROGRAM OF STUDIES 5
-PROGRAM STANDARDS 6
-COURSE CODE NUMBERS 7

PART II: ENERGY SOURCES COURSE GUIDE (# 10038)

-RATIONALE & OBJECTIVES 9
-GUIDELINES FOR IMPLEMENTATION 10
-TAXONMETRIC STRUCTURE 17
-COURSE DESCRIPTION & SPECIFICATION 18
-SUGGESTED INSTRUCTIONAL UNITS 19
-INDIVIDUAL UNIT SPECIFICATIONS 20
(Unit Objectives, Content Outline, Selected Student Competencies & Sample Learning Activities):

UNIT #

I. Introduction to Energy Sources 20
II. Chemical Energy Sources 25
III. Electrical Energy Sources 27
IV. Solar Radiated (Light/Thermal) Energy Sources 31
V. Mechanical Energy Sources 35
VI. Nuclear/Atomic Energy Sources 40
VII. Geothermal Energy Sources 44

-REFERENCES 46

BASIC BELIEFS ABOUT INDUSTRIAL ARTS

INDUSTRIAL ARTS IS .....

- *an educational discipline founded upon the knowledge base of technology - the means by which material things are produced.
- *an instructional program affording boundless opportunities for learning how technology has been, is now and will be basic to human desires and needs.
- *a fundamental educational program that can serve educational priorities, whether they are academic education, general education, vocational education, career education, ad. inf.
- *an activity based curriculum enabling students to learn through doing.
- *logically a discipline with a curriculum continuum from grade K through 12.

INDUSTRIAL ARTS IS JUSTIFIED BECAUSE .....

- *all persons need to know about the technological environment, the material culture, and industry because they are economically, socially and emotionally affected by them.
- *all persons must make a career choice from an extremely large and increasing number of occupations that are affected by technology; therefore, they should have opportunities to develop interests, uncover talents, explore technical and applied science fields and study occupations.
- *all persons must select, buy, use, and maintain the products of industry -- houses, automobiles, appliances, clothes, furniture and items of a never ending list. A knowledge of products, their manufacture, characteristics, advantages and disadvantages makes for intelligent consumption.
- *all persons need recreational, leisure time and avocational outlets.
- *all persons need to have opportunities to develop planning, creative, problem solving and technical skills in harmony with their inherent desire to seek the better way.

INDUSTRIAL ARTS CAN HELP THE STUDENT TO .....

- *gain an understanding of industry and technology.
- *discover interests and talents.
- *develop techniques in problem solving.
- *develop basic skills in the safe use of tools and machines.
- *make informed and meaningful occupational choices.
- *acquire interests in avocational pursuits and hobbies.
- *develop safe working habits.
- *apply other school subjects.
- *become a wiser consumer.
- *develop creativity.
- *develop pride in work well done.
- *work cooperatively with others.

THE INDUSTRIAL ARTS MISSION

The mission of Industrial Arts Education is to assist the student in developing an understanding about industry and technology and in the discovery and development of individual potential.

GOALS

Consistent with their abilities, interests and educational needs:

1. Industrial Arts students at the middle or junior high school level will be aware of employment and/or self-employment opportunities and requirements for use in making career choices and in determining their educational programs.

2. Industrial Arts students at the senior high school level will acquire technical competencies in preparation for advanced vocational or technical education programs.

3. Industrial Arts students at the senior high school level will acquire competencies that lead to responsible citizenship through technological understanding, consumer knowledge and the productive use of leisure time.

INDUSTRIAL ARTS: AN OFFICIAL DEFINITION

> Industrial Arts education programs means those education programs which pertain to the body of related subject matter, or related courses, organized for the development of understanding about the technical, consumer, occupational, recreational, organizational, managerial, social, historical, and cultural aspects of industry and technology including learning experiences involving activities such as experimenting, designing, constructing, evaluating, and using tools, machines, materials, and processes which provide opportunities for creativity and problem solving or assist individuals in the making of informed and meaningful occupational choices or which prepare them for entry into advanced trade and industrial or technical education programs.

INDUSTRIAL ARTS INSTRUCTIONAL OBJECTIVES

Industrial Arts students at the Senior High School Level will acquire competencies that lead to responsible citizenship through technological understanding, consumer knowledge and the productive use of leisure time. The program stresses the following instructional objectives:

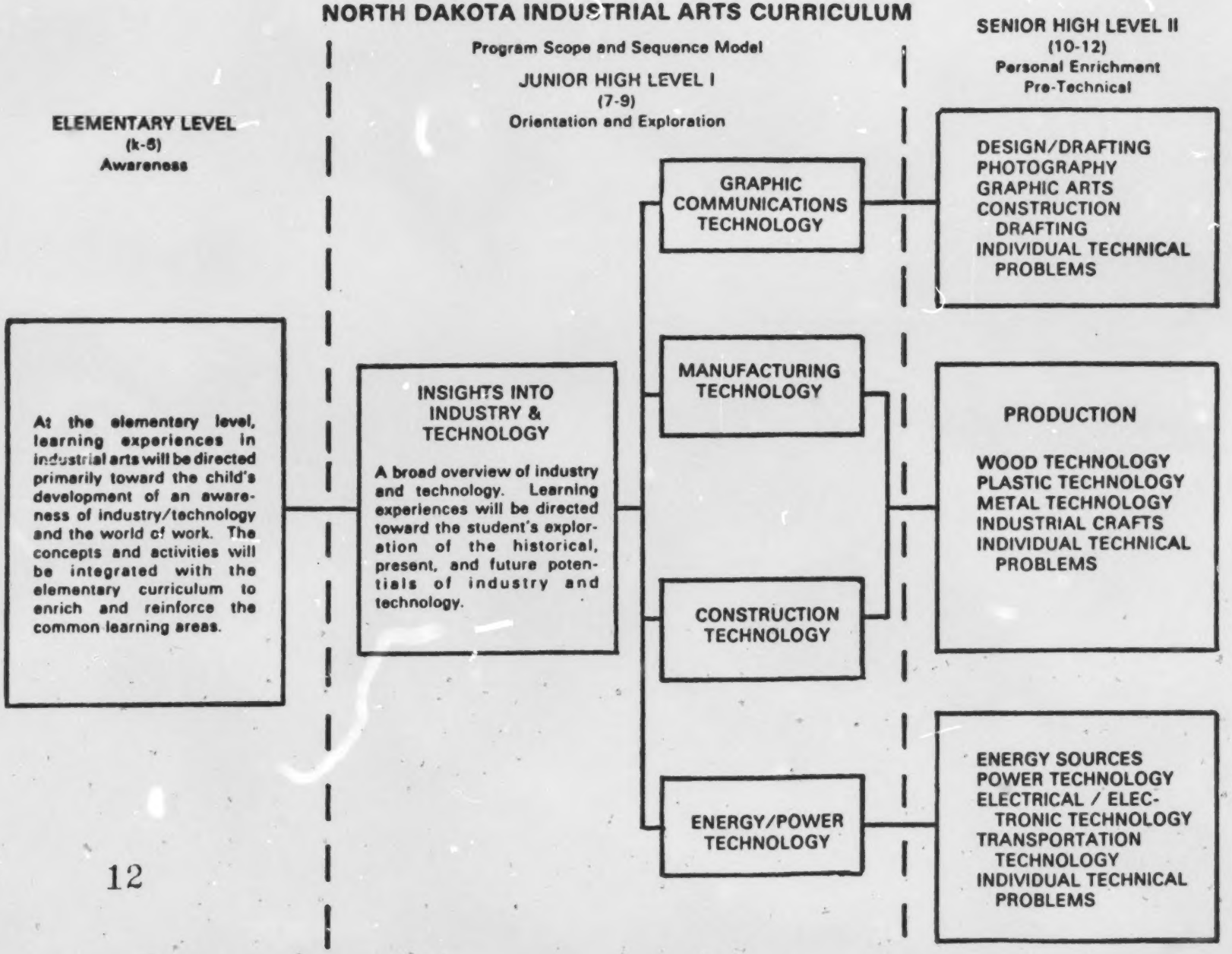
1. Develop an insight and understanding of industry and technology, its place in our society and the free enterprise system.
2. Discover and develop individual talents, aptitudes, interests, and potentials as related to industry and technology.
3. Develop an understanding of industrial processes and the practical application of scientific principles.
4. Develop technical problem-solving and creative abilities involving the use of materials, processes, and products of industry and technology.
5. Develop an understanding of industrial and technological career opportunities and their requirements and develop those traits which will help students obtain and maintain employment.

As determined by Title II of PL No. 94-482, the Vocational Education Act of 1976 and the State Board for Vocational Education, the purpose of funding industrial arts programs with vocational monies will be to:

1. Assist individuals in the making of informed and meaningful occupational and educational choices.
2. Prepare individuals for enrollment in advanced or highly skilled vocational and technical programs.

NORTH DAKOTA INDUSTRIAL ARTS CURRICULUM

Program Scope and Sequence Model


ELEMENTARY LEVEL
(k-6)
Awareness
At the elementary level, learning experiences in industrial arts will be directed primarily toward the child's development of an awareness of industry/technology and the world of work. The concepts and activities will be integrated with the elementary curriculum to enrich and reinforce the common learning areas.
JUNIOR HIGH LEVEL I
(7-9)
Orientation and Exploration
INSIGHTS INTO INDUSTRY & TECHNOLOGY
A broad overview of industry and technology. Learning experiences will be directed toward the student's exploration of the historical, present, and future potentials of industry and technology.
GRAPHIC COMMUNICATIONS TECHNOLOGY
MANUFACTURING TECHNOLOGY
CONSTRUCTION TECHNOLOGY
ENERGY/POWER TECHNOLOGY
SENIOR HIGH LEVEL II
(10-12)
Personal Enrichment
Pre-Technical
DESIGN/DRAFTING
PHOTOGRAPHY
GRAPHIC ARTS
CONSTRUCTION DRAFTING
INDIVIDUAL TECHNICAL PROBLEMS
PRODUCTION
WOOD TECHNOLOGY
PLASTIC TECHNOLOGY
METAL TECHNOLOGY
INDUSTRIAL CRAFTS
INDIVIDUAL TECHNICAL PROBLEMS
ENERGY SOURCES
POWER TECHNOLOGY
ELECTRICAL / ELECTRONIC TECHNOLOGY
TRANSPORTATION TECHNOLOGY
INDIVIDUAL TECHNICAL PROBLEMS

THE INDUSTRIAL ARTS PROGRAM OF STUDIES

LEVEL	GOAL	PROGRAM
II HIGH SCHOOL (Grades 10, 11, & 12)	1. Personal Enrichment 2. Pre-Technical	GRAPHIC COMMUNICATIONS TECHNOLOGY *Design/Drafting *Photography *Graphic Arts *Construction Drafting *Industrial Technical Problems ENERGY/POWER TECHNOLOGY *Energy Sources *Power Technology *Electrical/Electronic Technology *Transportation Technology *Individual Technical Problems PRODUCTION TECHNOLOGY *Wood Technology *Metal Technology *Plastic Technology *Industrial Crafts *Individual Technical Problems INDIVIDUAL TECHNICAL PROBLEMS (Multiple Offerings)
I JUNIOR HIGH SCHOOL (Grades 7, 8, &9)	1. Orientation 2. Exploration	*Insights into Industry and Technology *Graphic Communications Technology *Manufacturing Technology *Construction Technology *Energy/Power Technology

PROGRAM STANDARDS FOR INDUSTRIAL ARTS

ELEMENTS OF QUALITY INDUSTRIAL ARTS PROGRAMS

The success and quality of programs in industrial arts education depends upon elements that influence the quality of programs. Industrial arts must be responsive to the following elements:

A. GOALS AND OBJECTIVES: Program goals and objectives are established that provide the inspiration and guidance in program development, operation and evaluation.

B. INSTRUCTIONAL STAFF: The instructional staff is competent and meet necessary qualifications.

C. INSTRUCTIONAL PLAN: Selected subject matter is appropriate to learner's level and consistent with curriculum and course goals and objectives.

D. STUDENT ORGANIZATIONS: The establishment and operation of effective student organizations.

E. FACILITIES AND EQUIPMENT: Instructional facilities are well-designed, located and supportive of accomplishing curricular goals. (Refer to Educational Specifications for Industrial Arts Instructional Facilities Handbook, 1978.)

F. SPECIAL NEEDS: The program must provide for disadvantaged and handicapped students.

G. ADVISORY COMMITTEES: The establishment and effective use of industrial arts advisory committees.

H. GUIDANCE: The teacher's role in guidance.

I. ADMINISTRATION: Administration of the industrial arts program.

J. EVALUATION: Evaluation procedures are planned and implemented to assure continual program improvement.

NOTE: For further information on program standards, refer to the NORTH DAKOTA VOCATIONAL/TECHNICAL EDUCATION PROGRAM STANDARDS, Section 11.1 to 11.7.

INDUSTRIAL ARTS COURSE CODE NUMBERS
(Vocationally Funded)

Insights Into Industry and Technology	10001
Construction Technology	10011
Manufacturing Technology	10021
Wood Technology	10023
Metal Technology	10026
Plastic Technology	10029
Energy and Power Technology	10031
Electrical/Electronic Technology	10033
Energy Sources	10038
Power Technology	10039
Graphic Communications Technology	10051
Graphic Arts	10052
Design/Drafting	10053
Photography	10054
Construction Drafting	10056
Transportation	10061
Industrial Crafts	10080
Individual Technical Problems	10091
Individual Technical Problems	10092

PART II:

ENERGY SOURCES COURSE GUIDE

(# 10038)

ENERGY SOURCES

Rationale:

The purpose of studies in the energy/power area is to develop a realization, through activity-oriented instruction, that energy availability, conversion, efficient usage, conservation, and futuristic concerns are essential to life. Studies about energy/power involve classroom and hands-on activities. These studies should prepare the student to consider the socioeconomic and environmental impacts and the occupational aspects of the energy/power field.

The purpose of a course concerned with energy sources is twofold. First, all life forms and activities hinge upon energy, and thus, an understanding of energy sources is fundamental to wise applications of energy in an industrial and technological society. Second, and perhaps more important, students do, and will, live in a future increasingly affected and controlled by circumstances associated with energy sources. Therefore, if students are to be effective decision makers, workers and citizens, they must understand energy sources.

Course Objectives:

(1) The students will be exposed to energy sources career opportunities, educational programs and technical information in preparation for further study.

(2) The students will be exposed to information and competencies related to major energy sources; including where they come from, what can be done with them, why they would be used, and possible associated problems.

(3) The students will be exposed to information and problem solving strategies that lead to responsible citizenship through technological understanding, consumer knowledge and the productive use of leisure time as related to energy sources.

Guidelines For Implementation

Success in the classroom or laboratory depends on many factors. Foremost among these is the planning effort on the part of the teacher. Educational programs must be flexible and adaptable. They must be flexible enough to remain adaptable to all locales, in numerous types of facilities, and with students possessing differing values and interest. Therefore, a successful program must be capable of application in both small and large schools.

The industrial arts program recommended by these course guides are designed to meet individual student needs. They provide teachers with guidelines for a well balanced program with suggested teacher options in each of the three major technical study areas: (1) Graphic Communications; (2) Energy/Power; and (3) Production. The North Dakota secondary school industrial arts program suggests three levels of learning with an alternative curriculum approach at the Level II for those schools that cannot offer specific courses identified for each of the three technical study area due to the size of enrollments or other limiting factors.

The recommended scope and sequence of course offerings for the energy/power technical study area is illustrated on the sample program model on page 13. The Level I Energy/Power Technology course serves as an orientation and exploration experience. It is recommended as a prerequisite to the four Level II courses. The senior high Level II courses provide concentrated and indepth exploratory experiences in four study areas related to energy/power: (1) Energy Sources; (2) Power Technology; (3) Electrical/Electronic Technology; and (4) Transportation Technology. Since students at the senior high level display a wide range of interest, abilities, and life goals, the industrial arts program must provide a variety of learning experiences and course options to meet individual student needs, it is recommended that the specific course options be made available to students when possible. For the smaller mid-sized schools, it may not be feasible to offer all four of the specific courses identified for Level II. If that should be the case, it is recommended that one or two of the courses be offered and supplemented by an ITP (Individual Technical Problems) course as a Level II alternative. (See ITP Course specifications on page 14.) This course is designed to provide multiple learning experiences in the technical area of energy/power to meet individual needs of students.

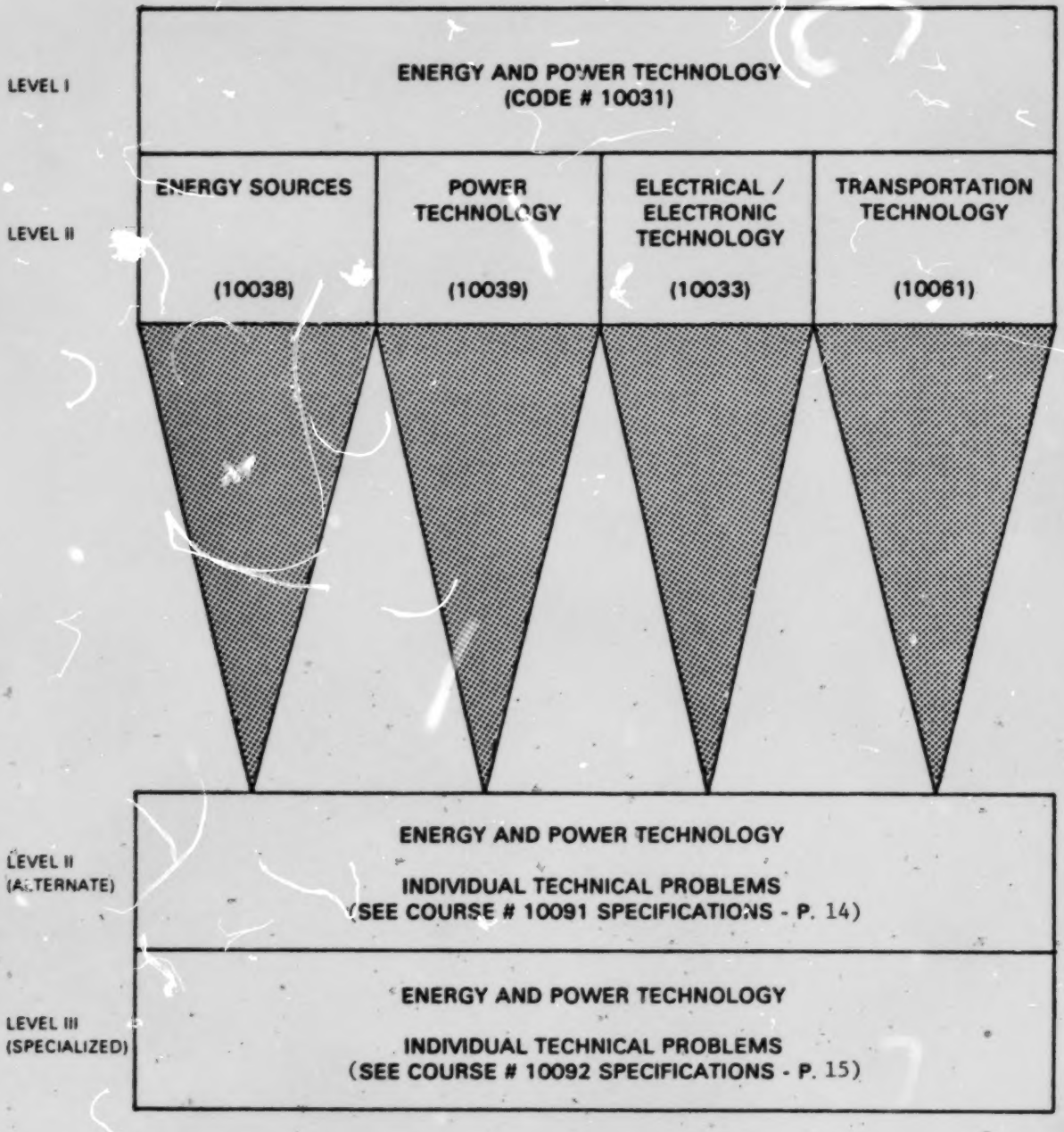
The Level III ITP specialized course (Code #10092 is suggested for students in larger programs who have had the Level II indepth exploratory courses in energy/power and desire to study a specialized aspect related to any phase of energy/power technology. The student may select a technical problem in such areas as alternate energy sources, energy conversion, transmission, and others. (See pages 15 and 16 for the specific ITP specialized course specifications and technical problem options).

Guidelines For Implementing the Energy Sources Course

The information in this booklet is intended to be suggestive of content and activities which can be used as an 18 week course in energy sources. The course reflected in this booklet is structured to require a minimum of new equipment or laboratory renovation. The typical electronics/electricity and power lab equipment should be useful for many identified activities in the course.

All instructional activities are offered as a means to illustrate and reinforce the unit outline content. Further insights can be gained through the use of films, field trips, handouts, texts, etc., identified in the bibliographical section.

Units I, II and IX are intended to provide insights for each of the various energy sources (Units III, IV, V, VI, and VIII). Although units I, II and IX can be covered in the sequence as indicated in the outline, they also are of sufficient importance to merit being discussed with each individual energy source unit.



Sample Program Model

INDIVIDUAL TECHNICAL PROBLEMS

COURSE CODE: 10091

This individual technical problem course is designed for students who have not had the opportunity to enroll in specific Level II subject matter courses in the Energy/Power Technology cluster area. The course is designed to provide a means for meeting individual student needs through the offering of multiple activities in a number of technical areas in schools where separate courses are not available.

INDUSTRIAL ARTS PURPOSE

Personal Enrichment

Pre-Technical

GRADE LEVEL

11 - 12

COURSE LENGTH

One period per day

18 or 36 weeks

UNIT OF CREDIT

½ or 1 unit

RECOMMENDED PREREQUISITES

Level I Curriculum Courses

SELECTED STUDENT COMPETENCIES

NOTE: Individual student competencies and learning experiences are to be identified and developed on a contractual basis by the student and approved by the instructor for each problem.

SAMPLE LEARNING TOPICS

NOTE: Learning topics for the ITP are to be selected from the instructional units identified for each specific subject matter course. These courses include:

ENERGY/POWER:

-- Energy Sources, 10038
-- Power Technology, 10039
-- Electrical/Electronic Technology, 10033
-- Transportation Technology, 10061

INDIVIDUAL TECHNICAL PROBLEMS: ENERGY/POWER

COURSE CODE 10092

This individual technical problems course is designed for students who have had the Level II preliminary course of this cluster in the chosen area of study and intend to study specific advanced topic(s) in energy sources, power technology, electrical/electronic technology and/or transportation technology.

INDUSTRIAL ARTS PURPOSE

Personal Enrichment

Pre-Technical

GRADE LEVEL

11 - 12

COURSE LENGTH

One period per day

18 or 36 weeks

UNIT OF CREDIT

½ or 1 unit

RECOMMENDED PREREQUISITES

See Course Description

SELECTED STUDENT COMPETENCIES

Instruction in this industrial arts course is open to meet students needs. The following suggested objectives are meant to provide ideas for developing the student's program.

1. To prepare students for seeking advanced education in the area of energy/power.
2. To provide students the experiences in problem-solving, research and development, and technical report writing with regard to any chosen topic in energy/power.
3. To provide students with opportunities for exploration in energy/power systems and the practical application of scientific principles related to these systems.
4. To provide students with a broader understanding of career opportunities in energy/power.

10092
COURSE CODE

INDIVIDUAL TECHNICAL PROBLEMS:

ENERGY/POWER

SAMPLE LEARNING UNITS

ENERGY SOURCES:

I. Gasahol Production
II. Solar Heating and/or Cooling
III. Solar Photovoltaic Banks
IV. Wind or Water Energy Conversion Systems
V. Energy Storage Systems

POWER TECHNOLOGY:

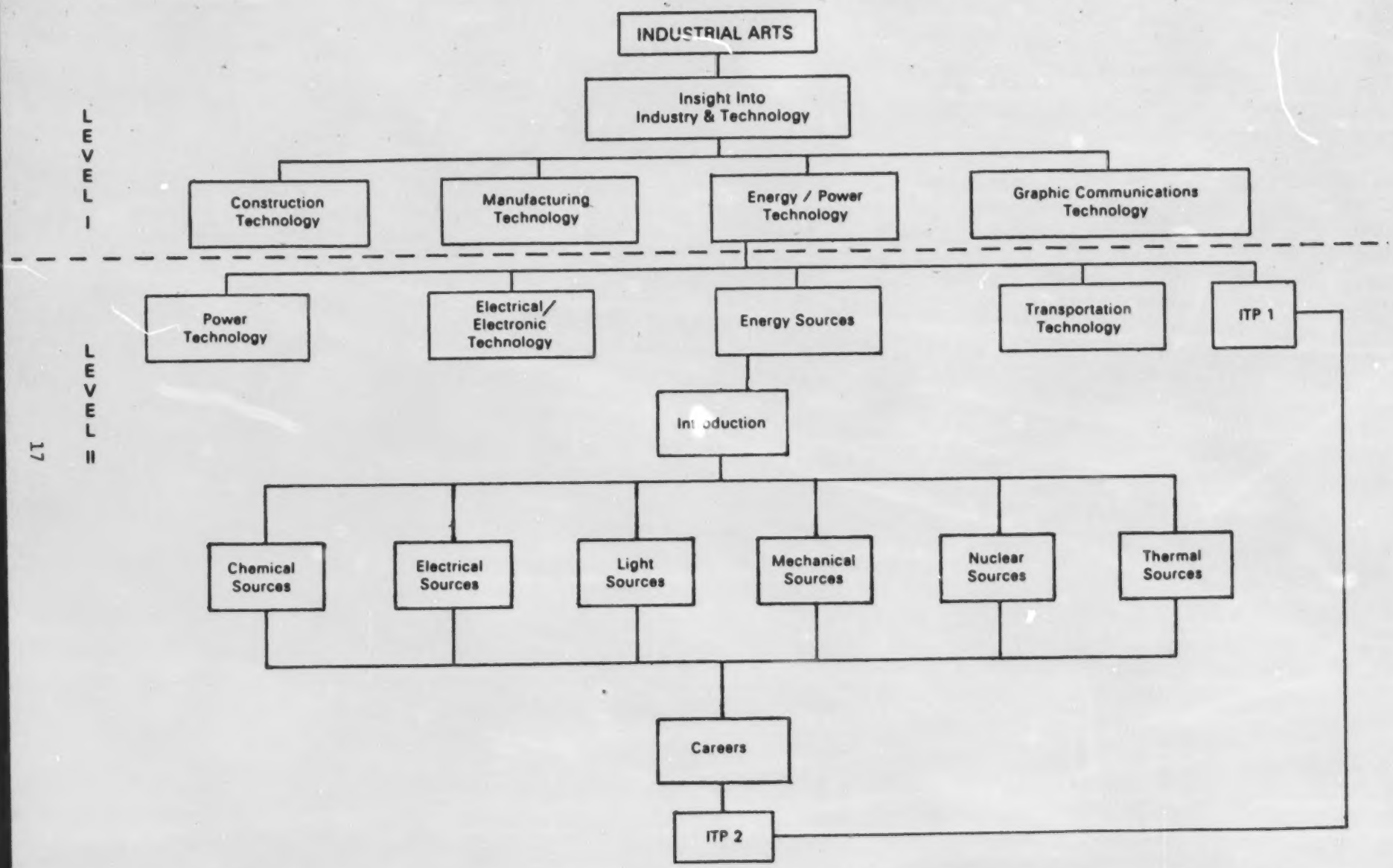
I. Stirling Engine/Heat Pump
II. Steam Engine
III. Dynomometers for System Analysis
IV. Hydraulic/Pneumatic Controls

ELECTRICAL/ELECTRONIC TECHNOLOGY:

I. Amateur Radio
II. Alarm Systems
III. Trouble Shooting Communications Equipment
IV. Vehicular and Other Microprocessor Control Units

TRANSPORTATION TECHNOLOGY:

I. Electrical Vehicle Propulsion
II. Linear Induction Motor Propulsion
III. Air Suspension Systems


INDUSTRIAL ARTS
Insight Into Industry & Technology
LEVEL I
Construction Technology
Manufacturing Technology
Energy / Power Technology
Graphic Communications Technology
LEVEL II
Power Technology
Electrical/ Electronic Technology
Energy Sources
Transportation Technology
ITP 1
Introduction
Chemical Sources
Electrical Sources
Light Sources
Mechanical Sources
Nuclear Sources
Thermal Sources
Careers
ITP 2

17

ENERGY SOURCES

COURSE CODE: 10038

This course is designed to help students learn about the application of energy and energy sources, along with the various collection systems. Students apply theory to practical collection or conversion of energy sources. Career opportunities are also explored.

INDUSTRIAL ARTS PURPOSE

Personal Enrichment

Pre-Technical

GRADE LEVEL

10 - 12

COURSE LENGTH

One period per day

18 weeks

UNIT OF CREDIT

½ unit

RECOMMENDED PREREQUISITES

None

SELECTED STUDENT COMPETENCIES

Experiences and activities of this industrial arts course should enable the student to:

1. Determine some of the economic and social effects which energy has on society.
2. Determine the working conditions in a service enterprise.
3. Demonstrate the principles of use of various energy sources.
4. Describe collection systems related to specific energy sources.
5. Exhibit safe practices with energy sources, in working with tools and equipment.
6. Demonstrate the ability to adjust and repair energy systems.
7. Exhibit efficiency in use of time.
8. Demonstrate a willingness to use good work habits of orderliness, cleanliness, and care of property.
9. Identify occupational preparation programs available in the area of energy sources.

10038
Course Code

ENERGY SOURCES

Suggested Instructional Units

	Class Periods (18 wks)	(36 wks)
I. Introduction to Energy Sources	5	
II. Chemical Energy Sources	5	
III. Electrical Energy Sources	25	
IV. Solar Radiated (Light/Thermal) Energy Sources	20	
V. Mechanical Energy Sources	25	
VI. Nuclear/Atomic Energy Sources	5	
VII. Geothermal Energy Sources	5	
TOTAL	90	

UNIT I

Introduction to Energy Sources

OBJECTIVES:

This unit is intended to provide the student with:

1. An introduction and orientation to Energy Sources, including reasoning for the course, historical elements, and other general information.

2. General information relating to energy sources jobs; their availability and necessary preparation for a career.

3. General laboratory safety information, including hazards, prevention, protection and corrective measures.

4. An understanding and appreciation of socioeconomic implications and impacts related to energy sources including depletion, environment, conservation, values and attitudes.

5. Specific information relative to safety concerns for individual energy sources.

1.0.0 Why Study Energy Sources?

2.0.0 What are the Major Sources?

3.0.0 Historical Elements

4.0.0 Occupation Information

- 4.1.0 What jobs are available?
- 4.2.0 Job preparation information

5.0.0 General Laboratory Safety

- 5.1.0 Hazards
- 5.2.0 Prevention
- 5.3.0 Protection
- 5.4.0 Corrective measures

UNIT I

6.0.0 Socioeconomic Implications/Impacts

- 6.1.0 Renewable/Depletion
- 6.2.0 Environmental/Ecological
- 6.3.0 Conservation
- 6.4.0 Values and Attitudes
- 6.5.0 Specific energy sources safety concerns

SELECTED STUDENT COMPETENCIES AND SAMPLE LEARNING ACTIVITIES FOR

Energy Sources

UNIT I: Introduction

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
A. Define the significance of energy sources in an industrial society.	A.1 Read and report on current events newspaper article activity, focusing on significance of energy in everyday affairs.
	A.2 Conduct simple surveys to determine awareness levels of various groups regarding availability, applications, problems, etc. relating to energy sources.
	A.3 Conduct library research for simple verbal or written reports about the significance of energy sources.
	A.4 View films on uses of energy sources.
B. Identify and describe the historical lineage of the major energy sources. Demonstrate an understanding of the historical lineage of the major energy sources.	B.1 Conduct a library search for report information about a historical energy source related item.
	B.2 Obtain and bring in an artifact for discussion/demonstration.
	B.3 Construct a three-dimensional model of an energy source (this should be done in conjunction with subsequent units.)

SELECTED STUDENT COMPETENCIES AND SAMPLE LEARNING ACTIVITIES FOR

Energy Sources

UNIT I: Introduction

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
C. Identify and describe major energy sources occupations.	C.1 Conduct on-site individual/group visitations to observe various occupations. C.2 Conduct a library search for report on various occupations. C.3 Contact various state/national agencies, institutions, etc., regarding needed training.
D. Identify, list and describe the major safety concerns in an energy sources course laboratory situation. Demonstrate proper safety practices in an energy sources laboratory situation.	D.1 Observe and analyze various potentially unsafe situations in your lab. D.2 Visit actual energy sources work sites seeking information about safety problems. D.3 Study available text materials. D.4 Write to OSHA seeking safety information. D.5 View films relating to safety. D.6 Involve the student in construction, research and development, experimentation and other hands-on experiences, with attention given to safety.

SELECTED STUDENT COMPETENCIES AND SAMPLE LEARNING ACTIVITIES FOR

Energy Sources

UNIT I: Introduction

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
E. Identify and describe various socioeconomic implications related to energy sources. Critically analyze the major socioeconomic implications related to energy sources. Demonstrate an awareness of various socioeconomic energy sources implications.	E.1 Conduct simple surveys of various groups at church, school, home, etc., to determine various levels of awareness relating to sources, safety, environmental problems, depletion, long range costs, etc. E.2 Conduct library report searches on similiar above listed concerns. E.3 Bring in a guest speaker. E.4 Use appropriate films on safety. E.5 Using small groups, construct models of socioeconomical problems/implications as identified above. E.6 Conduct on-site visitations to problem areas caused by energy sources.

UNIT II

Chemical Energy Sources

OBJECTIVES:

This unit is intended to provide the student with:

1. General information relative to chemical energy sources.
2. Information relative to economic & future considerations for individual chemical energy sources.
3. Extraction, refinement and storage factors for the major fossil energy sources.
4. Collection, storage, conversion and general uses for biofuels.

1.0.0 Fossil

- 1.1.0 Coal
- 1.2.0 Oil
- 1.3.0 Natural Gas
- 1.4.0 Extraction, refinement, storage and uses

2.0.0 Biofuels

- 2.1.0 Biomass
- 2.2.0 Agriculture
- 2.3.0 Aquaculture
- 2.4.0 Methane
- 2.5.0 Alcohol
- 2.6.0 Wood
- 2.7.0 Collection, storage, conversion
- 2.8.0 Uses/Applications

3.0.0 Economic/Future considerations

SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR

Energy Sources

UNIT II: Chemical Energy Sources

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
A. Identify and describe the major fossil energy sources. Identify and describe the fundamental extraction, refinement and storage processes used with major fossil sources.	A.1 Survey available text materials. A.2 Show films pertaining to chemical energy sources. A.3 Bring in guest speakers. A.4 Visit a extraction site or a refinery. A 5 Construct 3-dimensional scale model. A.6 Diagram and label extraction/ refinement processes.
B. Identify and describe the major biomass energy sources. Analyze the various economic considerations involved in selection of a biomass source. Demonstrate an awareness of biomass collection, storage, conversion or uses.	B.1 Survey text materials in classroom/library. B.2 Show films pertaining to biofuel sources and uses. B.3 Bring in guest speakers. B.4 Visit an operating biomass plant. B.5 Construct a model or actual working biomass device. B.6 Conduct a simulated cost analysis of a selected bio source. B.7 Diagram and label the various bio source components/principles in selected sources.

UNIT III

Electrical Energy Sources

OBJECTIVES:

This unit is intended to provide the student with:

1. General information about electrical energy sources; including electron theory, magnetism, current flow and circuitry, measurement and uses (conversions).

1.0.0 Electron Theory

- 1.1.0 Electron, protrons, neutrons
- 1.2.0 Natural electrical generation
  - 1.2.1 Friction
  - 1.2.2 Lightning
  - 1.2.3 Natural magnetism
- 1.3.0 Direct conversions
  - 1.3.1 Chemical
  - 1.3.2 Light
  - 1.3.3 Mechanical
  - 1.3.4 Thermal
  - 1.3.5 Nuclear

2.0.0 Magnetic

- 2.1.0 Natural
  - 2.1.1 Earth
  - 2.1.2 Lodestone
- 2.2.0 Electronmagnetic
  - 2.2.1 Induction
  - 2.2.2 Moving magnet
  - 2.2.3 Changing magnetic field

3.0.0 Current Flow

- 3.1.0 Alternating
- 3.2.0 Direct

UNIT III

4.0.0 Circuits

- 4.1.0 Parallel
- 4.2.0 Series

5.0.0 Electrical Measurement

- 5.1.0 Voltage
- 5.2.0 Current
- 5.3.0 Resistance
- 5.4.0 Power

6.0.0 Ohm's Law

SELECTED STUDENT COMPETENCIES AND SAMPLE LEARNING ACTIVITIES FOR

Energy Sources

UNIT III: Electrical Energy Sources

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
A. List and define electron theory, and how it functions.	A.1 Show films on the diverse uses of electrical energy.
	A.2 Construct a three-dimensional model of an appropriate device for experimentation.
	A.3 Conduct a search of available text materials for report purposes focusing on one use for converted electrical energy.
B. List and define magnetic energy sources, and their functioning.	B.1 Construct and experiment with a magnetic device.
Identify and differentiate between natural and induced electrical energy sources.	B.2 Disassemble/reassemble devices which use electromagnets and/or permanent magnets to discern their functioning.
Identify and describe the major uses of magnetic energy.	B.3 Develop a report relating to electromagnet theory or application.
C. Demonstrate a working understanding of current flow, circuitry, electrical measurement and Ohm's law.	C.1 Use a V.O.M. to test various circuits in various devices, taking readings to apply to Ohm's law for determining unknown values.
Identify, describe and differentiate between alternating/direct current, parallel/series circuits; and voltage/current/resistance.	C.2 Construct simple series and parallel circuits with either AC or DC power to be tested with a V.O.M., again using Ohm's law to determine unknowns.
	C.3 Visit industrial sites to observe and analyze the various applications of electrical measurement. (A power generating station would be a good selection).

SELECTED STUDENT COMPETENCIES
AND SAMPLE LEARNING ACTIVITIES
FOR

Energy Sources

UNIT III: Electrical Energy Sources

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
	C.4 Assemble a series string of photovoltaic cells and use it to power a small device or to charge an AA size battery. Measure and report on its output voltage, current and power when exposed to various varying levels of sunlight.

UNIT IV

Solar Radiated (Light/Thermal) Energy Sources

OBJECTIVES:

This unit is intended to provide the student with:

1. Information about indirect solar sources, including fossil fuels, water cycle, helio chemical and wind.
2. Helioelectric (direct) source factors, including magnification, cells and thermovoltaic.
3. Heliothermal (solar) information, including distillation, dryers, heaters, collection and storage.

1.0.0 Ultraviolet, Visable, Infrared

2.0.0 Indirect Solar Sources

- 2.1.0 Fossil fuels
- 2.2.0 Water cycle
- 2.3.0 Heliochemical (photosynthesis)
- 2.4.0 Wind

3.0.0 Direct/Helioelectric Sources

- 3.1.0 Concentration/magnification
- 3.2.0 Thermopile
- 3.3.0 Photogalvanic cell
- 3.4.0 Solar cells

4.0.0 Heliothermal

- 4.1.0 Distillation
- 4.2.0 Dryers
- 4.3.0 Heaters
  - 4.3.1 Water
    - 4.3.1.1 Flat plate
    - 4.3.1.2 Thermosyphon

4.3.2 Air

4.3.2.1 Trombe type wall system
4.3.2.2 Passive

4.4.0 Cooling systems

4.4.1 Night sky radiation
4.4.2 Evaporation

4.5.0 Collection

4.5.1 Design
4.5.2 Materials
4.5.3 Construction

4.6.0 Storage

4.6.1 Rock bed
4.6.2 Concrete wall
4.6.3 Water

SELECTED STUDENT COMPETENCIES AND SAMPLE LEARNING ACTIVITIES FOR

Energy Sources

UNIT IV: Solar Radiated Energy Sources

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
A. Define and cite examples/ applications of ultraviolet, visible and infrared sources.	A.1 Research available text materials to report on ultra-violet, visible and infrared sources and their applications. A.2 View films pertaining to solar photovoltaie devices and/or sources. A.3 Bring in a guest lecturer.
B. Identify, describe and differentiate between the major indirect solar sources, citing examples/applications of each.	B.1 Prepare a report on one of the major indirect solar sources. B.2 Diagram and label an indirect solar source. B.3 Write to the Department of Energy for information about direct solar sources.
C. Identify and describe applications for the major direct/helioelectric sources.	C.1 View on site, direct solar sources. C.2 Construct and test a 3-dimensional direct solar model. C.3 Conduct a simple community survey (church, home, school, neighbors) to discover how many people know what a direct solar energy source is.

SELECTED STUDENT COMPETENCIES AND SAMPLE LEARNING ACTIVITIES FOR

Energy Sources

UNIT IV Solar Radiated Sources

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
D. Identify, describe and differentiate between major heliothermal sources. Identify and describe applications of the major heliothermal sources. Identify, describe, differentiate between and demonstrate a working understanding of major heliothermal collection and storage systems.	D.1 View films on heliothermal systems. D.2 Visit an actual heliothermal application. D.3 Construct a functional 3-D model of full-size heliothermal device. D.4 Diagram and label a heliothermal source. D.5. Prepare a report on heliothermal sources; their applications, future projections, etc.; based on available text, personal interviews, guest lecturers, etc. D.6 Structure experiments, contrasting and comparing various types, applications, problems, etc. (See examples of appropriate reference/ experiment materials at conclusion of the guide).

UNIT V

Mechanical Energy Sources

OBJECTIVES:

This unit is intended to provide the student with:

1. General information about mechanical energy sources; including, power input, control, and mechanical advantage.
2. General information about wind energy.
3. General information about water energy.

1.0.0 Power Input

- 1.1.0 Reciprocating motion
- 1.2.0 Rotary motion
- 1.3.0 Linear motion
- 1.4.0 Inertia
- 1.5.0 Momentum
- 1.6.0 Acceleration

2.0.0 Control

- 2.1.0 Basic machines
  - 2.1.1 Lever
  - 2.1.2 Wheel & axle
  - 2.1.3 Screw
  - 2.1.4 Pulley
  - 2.1.5 Wedge
- 2.2.0 Control Devices
  - 2.2.1 On-off switching
  - 2.2.2 Direction
  - 2.2.3 Speed and force

3.0.0 Mechanical Advantage

- 3.1.0 Friction, heat
- 3.2.0 Efficiency
- 3.3.0 Force, distance, time, speed, work
- 3.4.0 Power, torque, horsepower

UNIT V

4.0.0 Wind

4.1.0 Historical aspects

4.1.1. Windmills

4.1.1.1 Vertical
4.1.1.2 Horizontal
4.1.1.3 Water Pumper

4.2.0 Airfoil principles

4.2.1 Wind speed

4.2.2 Air pressure

4.3.0 Climate and atmospheric conditions

4.4.0 Wind driven generators/alternators

4.4.1 Selection
4.4.2 Output
4.4.3 Storage

4.5.0 Blades and hubs

4.5.1 Materials selection & design
4.5.2 Construction
4.5.3 Efficiency

4.6.0 Wind machine accessories

4.6.1 Tower, storage, governor, etc.

5.0.0 Water

5.1.0 Historical aspects

5.1.1 Undershot
5.1.2 Overshot
5.1.3 Turbine

5.2.0 Basic principles

5.2.1 Motion of falling water
5.2.2 Waterflow and water head
5.2.3 Measuring water power

5.2.3.1 Height of head, flow rate, horsepower

UNIT V

5.3.0 Tidal

5.4.0 Waves

5.5.0 Dams

5.6.0 Channels, sluices, pipes

5.7.0 Construction factors

SELECTED STUDENT COMPETENCIES AND SAMPLE LEARNING ACTIVITIES FOR

Energy Sources

UNIT V: Mechanical

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
A. Identify, describe, differentiate between, and cite examples of various mechanical power input devices and systems.	A.1 Lecture; view films; bring in a mechanic, engineer, power company employee, or other resource person; structure appropriate readings based on one of the recommended texts (at guide's conclusion); assign reports; conduct on-site visitations to a power company, gas stations, auto dealership, garage, boiler room, etc.; and most important, discuss all of the above.
B. Identify, describe, and cite examples of various mechanical elements and devices.	B.1 (See A.1)
C. Identify, describe cite examples of, and demonstrate a working understanding of principles and components involved in mechanical advantage.	C.1 (See A.1) C.2 Have students disassemble and reassemble various mechanical devices (engines, transmissions, motors, pumps, differentials, etc.) Diagram their functioning and analyze, in writing, their major principles and functioning - How does it work?
D. Identify, describe and cite examples of principles, components, uses of, and historical aspects involved in wind as an energy source.	D.1 Reconstruct a water pump wind mill. D.2 Construct a working model of a wind mill. D.3 On-site visitations of functioning machines.

SELECTED STUDENT COMPETENCIES AND SAMPLE LEARNING ACTIVITIES FOR

Energy Sources

UNIT V: Mechanical

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
	D.4 Bring a windmill/machine owner to class for discussion purposes.
	D.5 Diagram and label a windmill and its components.
	D.6 Using available periodicals, texts, films. etc., seek out information for a written/ verbal report on methods of harnessing wind energy.
E. Identify, describe and cite uses or examples of principles, components, and historical aspects involved in water as an energy source.	E.1 Construct and experiment with a water energy source device.
	E.2 Diagram/sketch a water device and label its components.
	E.3 Search out information relative to water power applications.
	E.4 Visit a hydropower station.
	E.5 Show films on hydropower sources.
	E.6 Write a paper identifying and analyzing the major principles involved in water power as an energy source.
	E.7 Write a letter to one or more of the big three auto firms (or other companies) requesting information on power control devices.

UNIT VI

Nuclear/Atomic Energy Sources

OBJECTIVES:

This unit is intended to provide the student with:

1. General information about nuclear energy, including atomic theory, radiation, molecular theory etc.
2. Specific information about nuclear fuels, reactor components, and fission and fusion functioning.
3. General information about environmental concerns relating to nuclear energy.

1.0.0 Fundamental Elements

- 1.1.0 Atom
  - 1.1.1 Protons, electrons, nucleus
- 1.2.0 Radiation
  - 1.2.1 Alpha, beta, gamma
- 1.3.0 Molecule
  - 1.3.1 Motion
  - 1.3.2 Heat
- 1.4.0 Substance (matter)
- 1.5.0 Chemical compounds
- 1.6.0 Elements
  - 1.6.1 Isotopes

2.0.0 Nuclear Fuels

- 2.1.0 Solids, liquids
- 2.2.0 Uranium
- 2.3.0 Hydrogen, tritium
- 2.4.0 Thorium, radium, plutonium
- 2.5.0 Availability

UNIT VI

3.0.0 Reactor Components

- 3.1.0 Neutron
- 3.2.0 Moderator
- 3.3.0 Control rod assembly
- 3.4.0 Coolant
- 3.5.0 Fuel
- 3.6.0 Concrete enclosure

4.0.0 Nuclear Fission

- 4.1.0 Splitting nucleus
- 4.2.0 Chain reaction

5.0.0 Nuclear Fusion

- 5.1.0 Uniting two nuclei

6.0.0 Environmental Concerns

- 6.1.0 Waste materials handling/storage
- 6.2.0 Long range costs

SELECTED STUDENT COMPETENCIES AND SAMPLE LEARNING ACTIVITIES FOR

Energy Sources

UNIT VI: Nuclear/Atomic Sources

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
A. Identify, describe, and cite examples of the fundamental elements involved in nuclear/ atomic energy.	A.1 Lecture; view films; bring in a nuclear engineer, power company employee with atomic experince, or other appropriate resource person; structure appropriate readings based on one or more recommended texts (at guide's conclusion); assign reports; conduct on-site visitations to an atomic power station, atomic installation, and discuss all of the above activities at appropriate and meaningful occassions.
	A.2 Construct a three-dimensional model of a fusion or fission reactor.
	A.3 Prepare a paper identifying and analyzing the elements and theory of atomic energy.
B. Identify, describe and differentiate between the various nuclear fuels. List and describe possible problems with nuclear fuels availability.	B.1 Use films, readings, resource people and discussion to focus on fuels availability and environmental threats posed by nuclear sources, with emphasis on wastes transport and disposal.

SELECTED STUDENT COMPETENCIES AND SAMPLE LEARNING ACTIVITIES FOR

Energy Sources

UNIT VI: Nuclear/Atomic Sources

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
C. Identify and describe the various reactor components involved in nuclear energy sources.	C.1 Using various available resource materials, require students to determine the possible role nuclear sources may play in western culture's energy future; structure classroom debates/ discussion around the various responses. C.2 With the assistance of the instructor write a letter to General Electric, Westinghouse, M.I.T., Kettering Research, etc., requesting current information pertaining to some phase of nuclear energy.
D. Differentiate between the fission and fusion nuclear processes.	D.1 (See A.1 - C.2)
E. Identify and describe the various possible problems involved in nuclear energy sources.	E.1 (See A.1 - C.2)

UNIT VII

Geothermal Energy Sources

OBJECTIVES:

This unit is intended to provide the student with general information about geothermal sources; including basic elements, extraction factors, applications and uses.

1.0.0 Basic Elements

- 1.1.0 Molten earth core
- 1.2.0 Radioactive decay
- 1.3.0 Porous hot spots near water
- 1.4.0 Steam pressure

2.0.0 Extraction Factors

- 2.1.0 Depth of well
- 2.2.0 Size of find
- 2.3.0 Exploration limitations

3.0.0 Applications/Uses

- 3.1.0 Steam generation of electricity
- 3.2.0 Heat, etc.

SELECTED STUDENT COMPETENCIES AND SAMPLE LEARNING ACTIVITIES FOR

Energy Sources

UNIT VII: Geothermal Sources

SELECTED STUDENT COMPETENCIES	SAMPLE LEARNING ACTIVITIES
THE LEARNING ACTIVITIES SHOULD ENABLE THE STUDENT TO:	
A. Identify, describe and differentiate between the major geothermal energy sources elements.	A.1 View films; lecture, provide readings; assign papers/reports; construct a three-dimensional functional geothermal model; research the possible geothermal role in the U.S. future energy scene; assign students to critique a D.O.E. fact sheet (see bibliography at guide's conclusion); diagram and label elements, principles, etc., involved in the functioning of geothermal.
B. Identify and describe the various extraction factors relating to geothermal energy sources.	B.1 (See A.1)
C. Identify and describe the major uses for geothermal energy sources.	C.1 (See A.1)

REFERENCES

References:

1. Duffy, J.W. Power. McKnight, Bloomington, Illinois, 1972.

2. Geil, John J. Energy & Transportation: Power. MET Series, Prentice-Hall, Inc., Englewood, N.J., 1976.

3. Miller & Bohn. Power Mechanics. McKnight, Bloomington, Illinois, 1978.

Selected References:

1. Geil, John J. Industry & Careers. MET Series, Prentice-Hall, Inc., Englewood, N.J., 1976.

2. The Mother Earth News. Handbook of Homemade Power. Batam Books, N.Y., 1974.

3. Halacy, D.S. Earth, Water, Wind & Sun. Harper & Row, New York, 1977.

4. Schurr, Sam H. Energy in America's Future. John Hopkins University Press, Baltimore, 1979.

5. Stephenson, George E. Power Technology, Delmar Publishers, New York, 1973.

6. Prenis, John. Energy Book #1 & #2. Running Press, Philadelphia, Penn., 1975.

7. NSTA Factsheets 1-19. Department of Energy, Washington, D.C., 1979.

Other Sources, Annotated

1. Fuel & Energy Office, Capital Building, Bismarck, N.D. 58501. This office has numerous teaching aids, speakers, films, etc. most of which are free or inexpensive.

2. The Department of Energy Technical Information Center: P.O.Box 117, Oak Ridge, Tennessee, 37830 - will provide, free of charge, Energy Sources Activities for classroom purposes. These printed materials are both "Hands-on" and "Sit-down" types of materials, and were developed by teachers in the classroom.

3. Shell Oil Comapny, 1433 Sadler Circle, West Drive, Indianapolis, Indiana, 46239. Shell has many enery related films on various sources which can be obtained free of charge, simply by writing on school letterhead.

4. Local Utility Companies frequently have information, films, activities, tours, resource people, etc. available. Usually a phone call will get this started.

5. County Extension Agents might be helpful regarding energy sources, activities, information, etc.

6. Minnesota Mining & Manufacturing Company has available, through 3M Company - Box 33100, St. Paul, Minnesota, 55101, a set of transparencies titled "Energy-1978, Where America Stands on the Energy Crisis". Cost is about $20.00. Not only are sources covered, but much other information as well.